BIOLOGICAL EVALUATION OF SOUTHERN PINE BEETLE INFESTATIONS AT THE MARINE CORPS BASE, CAMP LEJEUNE IN NORTH CAROLINA

William A. Carothers and Debra Allen

ABSTRACT

The results of recent aerial surveys and ground checks indicate that southern pine beetle (SPB) (Dendroctonus frontalis) activity is increasing to epidemic levels at Marine Corps Base, Camp Lejeune. Ninety southern pine beetle infestations (74 confirmed, 16 suspected) have been detected since June 22, 1983 on the Base. Infestations are occurring in loblolly (Pinus taeda) and longleaf (P. palustris) pine stands. Susceptible host types (pine and pine hardwood >20 years of age) make up 46,500 acres of the managed areas of the Base. Drought and overstocked stand conditions are contributing to the initiation and expansion of infestations. Trees which provide military training areas, wildlife habitat, and timber may be threatened if infestations continue to expand in size or if spot proliferation occurs. Forest Pest Management recommends that a suppression project be initiated.

INTRODUCTION

On June 22, 1983 an aerial detection survey of Camp Lejeune was conducted by Base forestry personnel. Thirty-six areas of dead or dying pines were observed. Because of the pattern of mortality and the color of the tree crowns, these areas were suspected as being southern pine beetle infestations. Ground checks to confirm the causal agent were initiated. Subsequent surveys flown on August 15 and September 19 detected an additional 54 areas of dead and dying pines. To date, 74 of the 90 areas have been ground checked and confirmed as SPB infestations. Entomologists from the FPM Doraville Field Office conducted this evaluation from September 19-22, 1983 to determine the present status and trend of SPB populations at Camp Lejeune. The evaluation was completed with the assistance and cooperation of Mr. Julian Wooten, Mr. Ken Harrison, Mr. Peter Black, Mr. Albert Henry, and Mr. Robert Dennis.

Historical Information

Southern pine beetle infestations have occurred at the Base in the past. From 1968-1976 and again from 1979-1980 high southern pine beetle populations were present (Barry, 1968 and Barry, 1981). These outbreaks subsided as a result of timely suppression efforts by the Base forestry staff and biotic and abiotic factors detrimental to the initiation and growth of infestations. From 1981 until July of this year, SPB activity was at a low level. Slight increases in activity have been noted during the past two months on state and private lands in the northern coastal plain (Doggett, 1983A and Doggett, 1983B).

METHODS

Aerial Survey and Ground Check

During the aerial surveys, the locations of areas of dead and dying pines displaying symptoms consistent with southern pine beetle infestations (pattern of mortality and color variation in tree crowns) were plotted on a Camp Lejeune Special Map. No estimates of the number of trees affected per spot were made during the surveys because the Base forestry staff ground check all areas of pine mortality.

Twelve of the areas detected during the surveys were selected as sample spots for this evaluation. Since the information needed to stratify by size the spots observed during the surveys was unavailable, sample spots were selected on relative size (small, medium, large) as determined by the Base forestry staff. In each spot, the following information was collected: causal agent, diameter and height of twenty representative trees, the number of infested and vacated trees by crown color, basal area, and average age of the trees.

Suppression Project Criteria

The decision to recommend the initiation of a southern pine beetle suppression project is based on the following criteria:

Number of southern pine beetle spots per thousand acres of susceptible host type

One multiple tree spot per thousand acres of susceptible host type has historically been considered the lower threshold of an epidemic southern pine beetle population.

Green Tree:Red Tree Ratio

This ratio based on infested trees indicates how rapidly a SPB infestation is expanding.

Volume of timber currently infested and economic evaluation

The volume of timber currently infested is calculated from the data collected at the time of the ground check. This volume is then used in the Southern Pine Beetle Economic Evaluation Program (SPBEEP) to compute the benefit cost ratio, internal rate of return, targets for the volume of timber to be removed and the volume of timber protected by suppression efforts.

Entomological Judgment

Observations made during the ground check, historical information and experience, as well as consideration of impacts on wildlife and overall mission of the facility play a role in the decision making process.

RESULTS AND DISCUSSION

The aerial detection surveys located 90 spots of dead and dying pines on the Base. Figure 1 shows the location of the 74 spots which have been ground checked to date. Of the twelve spots sampled for this evaluation, eleven were actively infested by SPB. Assuming that our sample was representative, we estimate that 83 of the 90 total spots are currently active. Based on sampled spots, the size distribution of the 16 spots which have not been ground checked has been projected. By combining the known ground check data and the projected size of unchecked spots, we believe that at least 49 active multiple tree spots are present. Since 46,500 acres of susceptible host types (pine and pine hardwood >20 years of age) are present, there are 1.05 active multiple tree spots per thousand acres of host type. This indicates that southern pine beetle populations at Camp Lejeune have increased to the lower limit of an epidemic.

Table 1 presents the data collected in the sampled spots. The size of the sampled spots ranged from 6 to 219 trees. The percent of infested trees per spot ranged from 0 (the inactive spot) to 71 percent. The ratios of green infested to red infested trees ranged from a low of 0:13 to a high of 22:0. In all but two of the sampled spots the ratio was higher than 1:1 indicating that rapid spot growth can be expected. Green to red ratios found in the largest spots indicate the potential for large volume losses.

During the fall and early spring, the formation of new spots is likely. This spot proliferation occurs when beetles emerging from existing spots disperse some distance and initiate "satellite" infestations. To account for this process, a factor of 2.5 has been incorporated into the data used in the economic analyses.

If a suppression project is initiated, an estimated 91 MCF would be removed and 123 MCF would be protected. Detailed information regarding the analyses with and without a suppression project is contained in Tables 2 and 3.

The economic analyses deal only with the impact of SPB on timber resources. Because of the multiple use of forested lands at Camp Lejeune, activities other than forestry are likely to be impacted. Military training, wildlife habitat, recreation, and aesthetics may all be impacted if the current southern pine beetle infestations expand or proliferate. We cannot place a dollar amount on the value of these other uses but know that they are extremely important and should be protected.

While conducting this evaluation we noted the relative lack of SPB predators and parasitoids. This indicates that natural control is unlikely to occur in the spots in the near future. Symptoms of drought were very common. All species of vegetation are being affected but the consequences for the pine species are more severe. The only natural defense that pines have against southern pine beetle attack is the production of resin that may "pitch out" attacking beetles. In most of the spots sampled, drought conditions were so severe that few, if any, pitch tubes were produced. Even if rainfall for the rest of the year reaches normal levels, drought stressed trees will not fully recover in that period and will remain susceptible to attack. Overstocked stand conditions are also playing a role in spot initiation, growth and expected proliferation. Stocking expressed

as square feet of basal area per acre is a function of the number and size of the trees in a given area. The basal areas in the sampled spots were well above recommended levels indicating the need for thinning. Densely stocked stands are low in vigor. Increased competition between trees for sunlight, water, nutrients and growing space cause them to be stressed and therefore more susceptible to SPB.

RECOMMENDATIONS

Forest Pest Management recommends that a southern pine beetle suppression project be initiated on the Marine Corps Base, Camp Lejeune. This recommendation is based on the number of SPB spots per thousand acres of susceptible host type, the green to red infested tree ratios, the economic analyses, and the likely impact on activities other than timber production. In addition, we recommend that preventive measures be implemented to minimize the risk of future SPB infestations.

Removal of infested trees is the recommended suppression procedure for this time of the year. Cut and leave procedures may be used during the period June-October. A detailed discussion of suppression procedures, as well as preventive measures, follows.

CURRENT SUPPRESSION PROCEDURES

1. Removal of Infested Trees by Commercial Sale. When infested trees of merchantable size are accessible, they should be removed by commercial sale. Logging of the infested material should begin immediately. Contracts should be written to insure rapid removal and minimize damage to residual trees.

When practical, and if host type is present, a 40- to 70-foot buffer strip should be marked and cut adjacent to and ahead of the most recently infested trees. This practice is effective in reducing the possibility of "breakouts." A wider buffer strip may be necessary when large or rapidly expanding spots are encountered. When only a small volume of infested merchantable material occurs in a spot, noninfested trees surrounding the spot may be marked to provide an operable cut.

The order of priority for removing beetle-infested timber from a spot should be as follows:

--Trees in the buffer zone at the head(s) of the spot; if not removed within two weeks of marking, another visit and talley must be made in order to insure removal of all infested trees and an adequate buffer strip.

--Trees with fresh attacks and having young broods (usually the green, recently infested trees).

--Trees having nearly developed broods (usually the red and fading trees).

2. Piling and Burning. Unmerchantable or inaccessible SPB infestations can be suppressed by cutting, piling, and thoroughly burning the bark of infested

trees. The entire bark surface must be thoroughly burned to insure effective control. The order of priority for cutting, piling, and burning infested trees, particularly the large spots, is the same as paragraph (1) under "Removal of Infested Trees by Commercial Sale." Cutting a buffer strip is not recommended. To reduce the possibility of "breakouts," every effort should be made to locate and treat all green infested trees during the piling and burning operation.

3. Chemical Control. One chemical formulation recommended for SPB control is one-half percent lindane spray, with water as the carrier. This may be formulated from a 20 percent lindane emulsifiable concentrate at the rate of 11 pints of concentrate in enough water to make 55 gallons of spray. (Ratio of one part 20 percent lindane EC to 39 parts water).

Dursban (chlorpyrifos) is also registered for SPB control. It is available as a liquid, containing 4 pounds of insecticide per gallon of concentrate. The spray is prepared by mixing 2-2/3 fluid ounces of concentrate with water to make 1 gallon or 2.1 gallons of concentrate in 100 gallons of water. Dursban, a restricted-use pesticide, is to be applied only by or under the supervision of a certified pest control operator or other trained personnel responsible for insect control programs.

Sumithion was registered for SPB control in June 1982. It is available as an emulsifiable concentrate containing 8 pounds active ingredient per gallon. The spray is prepared by mixing 1.06 gallons of Sumithion 8E in 100 gallons of water.

Cut, limb, and buck all infested trees into workable lengths. Spray the infested bark surface to the point of runoff. A compressed air sprayer (3-gallon capacity or equivalent) is an ideal applicator. Infested logs must be turned two or three times to insure complete treatment of infested bark. Spray stumps and bark removed by woodpeckers. Low pressure sprayers may be used to treat large, accessible infestations.

The order of priority for cutting and spraying infested trees in large spots is the same as paragraph (1) under "Removal of Infested Trees by Commercial Sale." Cutting a buffer strip is not recommended. To reduce the possibility of "breakouts," every effort should be made to locate and treat all green infested trees during the chemical control operation.

Never spray trees from which SPB brood has emerged. Natural enemies of the SPB in these trees can then complete their development.

4. Cut-and-Leave. This control tactic reduces losses from spot growth and proliferation during the summer months. Cut-and-leave is designed to disrupt spot growth in small to medium-sized spots (40 active trees) by dispersing emerging beetles. These spots can be salvaged when markets or weather permit.

The following procedure is to be followed when using cut-and-leave:

(1) Identify all active trees within the spot.

(2) Fell all active trees toward the center of the spot.

(3) Fell a horseshoe-shaped buffer of green, uninfested trees around the most recently attacked trees at the head of the spot and leave them lying on the ground with crowns pointed toward the center of the spot. The buffer should be as wide as the average height of the trees in the stand. A smaller buffer may be used if weekly examinations of treated areas are conducted.

Cut-and-leave treatments should only be applied during the summer months between June and October. Spots with 10 or more infested trees should be treated first. As time permits, spots with less than 10 infested trees should also be treated if they contain trees with fresh attacks. In these smaller infestations where a specific head is not distinguishable, an adequate buffer strip (equivalent to the average height of the stand) and all infested and green uninfested trees within the spot should be felled.

PREVENTIVE MEASURES

The preceding represent only short-term, immediate suppression strategies. Preventive measures form an important part of the integrated pest management process. These measures are designed to minimize the factors known to predispose trees to attack by SPB. Some of the more significant preventive measures include:

1. Harvesting of Mature and Overmature Stands. As a result of the Biological Opinion issued by the U. S. Fish and Wildlife Service for the endangered red cockaded woodpecker, a rotation length of 100 years has been implemented for pine stands. While this rotation length favors establishment of the woodpecker colonies, it may also produce stands that are low in vigor and subject to attack by SPB. The goal of forest management practices at Camp Lejeune is to have an even distribution of stands in all age classes from 1 to 100 years. Currently a disproportionate amount of pine and pine hardwood stands fall in the age classes 30-70 years. Unless harvesting activities reduce the number of these stands, severe SPB outbreaks can be expected in the future because of the amount of physiologically mature timber present. It will be necessary to harvest and regenerate many of these stands to achieve the normal distribution desired.

2. Thinning Stagnated Stands. Overstocked stands are low in vigor and are more likely to be attacked. They should be thinned to a point that trees again show thrift and vigor.

3. Minimizing Impact of Natural Disturbances Which Cause Stand Stress. These factors include ice, wind, hail, animal damage, flooding, erosion, poor soil fertility, etc. Corrective measures include removal of individually damaged trees, wholesale salvage, improving drainage, fertilization, etc.

4. Minimizing or Eliminating Man-Caused Disturbances. Logging, pipeline, sewerline, and powerline construction, or other construction activites require use of heavy equipment, which causes tree skinning and soil compaction and significantly weakens trees. Efforts to minimize the damaging consequences of these activities can significantly reduce the possibility of their leading to SPB problems.

PRECAUTIONARY PESTICIDE USE STATEMENT

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key--out of the reach of children and animals--away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you used for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary landfill dump, or crush and bury them in a level, isolated place.

NOTE: Some states have restrictions on the use of certain pesticides. Check your state and local regulations. Also, because registration of pesticides are under constant review by the U. S. Department of Agriculture, consult your county agricultural agent or state extension specialist to be sure the intended use is still registered.

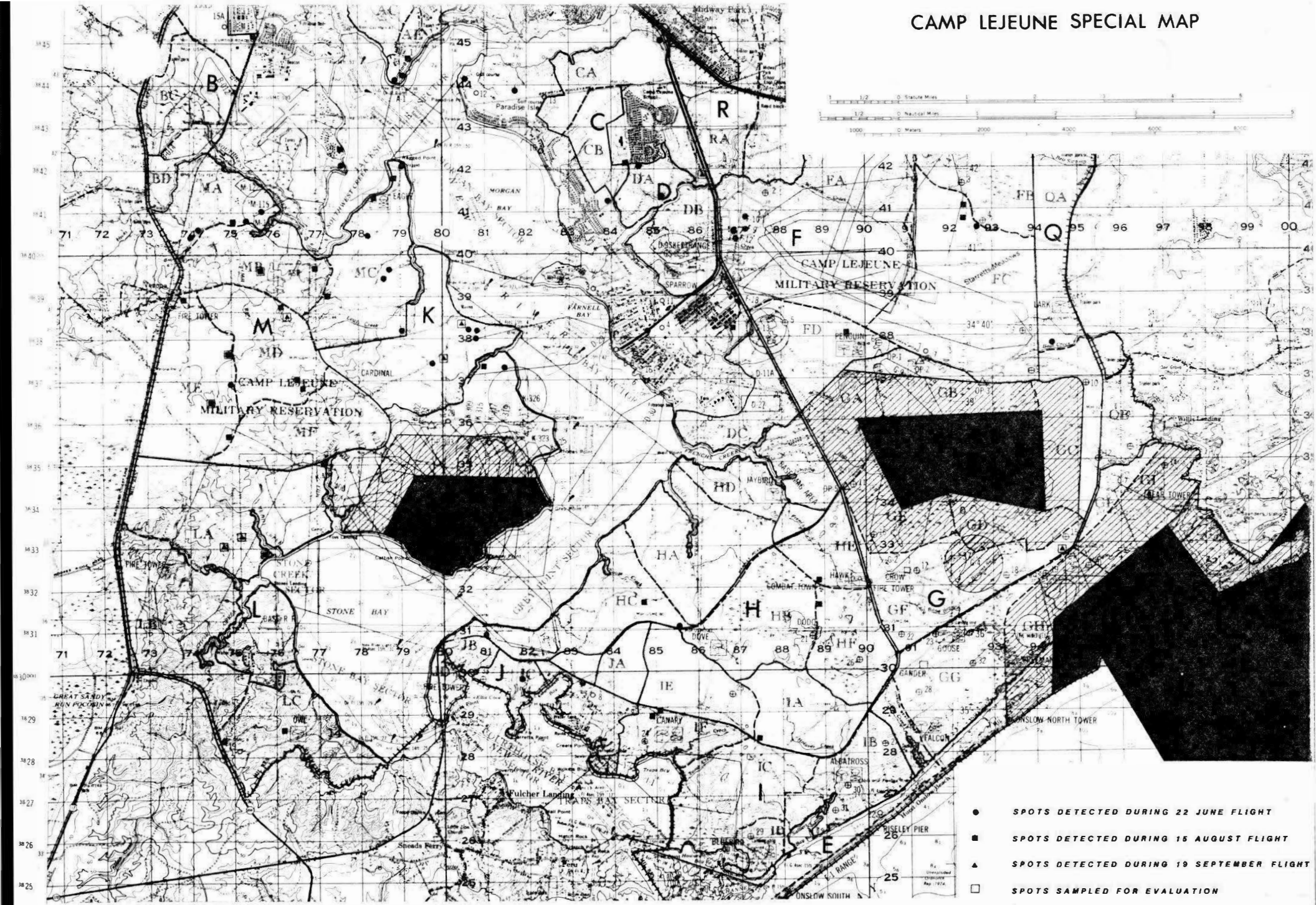

Fig. 1. Map showing locations of confirmed southern pine beetle spots, Marine Corps Base, Camp Lejeune, 1983.

Table 1. Summary of ground check data for Marine Corps Base, Camp Lejeune, September 1983.

Spot #	Vacated			Vacated Total	Infested			Infested Total	% Infested	G:R Ratio	BA	$\bar{x}$ DBH	$\bar{x}$ HT	$\bar{x}$ AGE	Volume MBF
	Green	Red	Black		Green	Red	Black								
1	1	3	0	4	2	0	0	2	33	2:0	130	15.3	70	42	1.34
2	4	14	10	28	27	5	0	32	53	5.4:1	160	10.0	46	34	4.27
3	1	10	5	16	35	2	0	37	70	17.5:1	160	10.5	50	40	4.89
4	2	3	14	19	22	0	0	22	54	22:0	90	12.4	44	34	4.1
5	0	3	0	3	2	0	0	2	40	2:0	70	9.6	29	29	.26
6	0	25	81	106	81	6	0	87	45	13.5:1	220	14.0	59	41	32.92
7	0	18	0	18	27	18	0	45	71	1.5:1	230	16.8	84	50	21.31
8	0	11	15	26	52	6	0	58	69	8.7:1	190	12.4	59	40	10.67
9	4	20	24	48	57	18	0	75	61	3.2:1	180	11.3	66	41	14.18
10	0	13	8	21	0	0	0	0	0	0:13	150	10.3	37	47	1.36
11	1	21	19	41	3	14	0	17	29	0.21:1	60	6.3	23	33	.85
12	3	48	34	85	115	19	0	134	61	6.1:1	150	9.5	37	43	12.75

Table 2.--Southern pine beetle economic analysis *for the Marine Corps Base, Camp Lejeune* at 4 percent discount rate.

CAMP LEJEUNE 09/30/85

WITHOUT A PROJECT

AGE	HARV OBJ.	VOLUME LOST (MCF)	SPOT GROWTH RATE	VOLUME THREAT (MCF)	GROWTH RATE (%)	AGE AT HARV.	VOLUME AT HARVEST (MCF)	PRICE AT HARV.	VALUE AT HARVEST	PRESENT VALUE
30	S/F	5	2.70	14	1.0	100	28	$ 3060	$ 85147	$ 5258
30	S/I	3	2.70	9	1.4	70	16	$ 1689	$ 27001	$ 5408
30	S/F	7	2.70	18	1.0	100	37	$ 3060	$ 113382	$ 7001
40	S/F	8	2.71	21	.7	100	32	$ 2510	$ 80024	$ 7315
40	S/I	5	2.71	14	.9	70	18	$ 1386	$ 25410	$ 7533
40	S/F	10	2.71	27	.7	100	43	$ 2510	$ 106699	$ 9753
50	S/I	3	2.71	7	.7	70	8	$ 1137	$ 9130	$ 4007
50	S/F	5	2.71	14	.6	100	17	$ 2059	$ 38340	$ 5187
TOTAL		46		123			200	$	$ 485134	$ 51461

VALUE OF THE VOLUME NOT SALVAGED (LOST) $ 27331

TOTAL VALUE LOST $ 78792

WITH A PROJECT

AGE	HARV OBJ.	VOLUME LOST (MCF)	SPOT GROWTH RATE	VOLUME THREAT (MCF)	GROWTH RATE (%)	AGE AT HARV.	VOLUME AT HARVEST (MCF)	PRICE AT HARV.	VALUE AT HARVEST	PRESENT VALUE
	S/F	0	2.70	0	1.0	100	0	$ 3060	$ 0	$ 0
30	S/I	0	2.70	0	1.4	70	0	$ 1689	$ 0	$ 0
30	S/F	0	2.70	0	1.0	100	0	$ 3060	$ 0	$ 0
40	S/F	0	2.71	0	.7	100	0	$ 2510	$ 0	$ 0
40	S/I	0	2.71	0	.9	70	0	$ 1386	$ 0	$ 0
40	S/F	0	2.71	0	.7	100	0	$ 2510	$ 0	$ 0
50	S/I	0	2.71	0	.7	70	0	$ 1137	$ 0	$ 0
50	S/F	0	2.71	0	.6	100	0	$ 2059	$ 0	$ 0
TOTAL		0		0			0	$	$ 0	$ 0

VALUE OF THE VOLUME NOT SALVAGED (LOST) $ 0

TOTAL VALUE LOST $ 0

PROJECT BENEFITS:	78792
TOTAL PROJECT COST:	35000
NET PRESENT VALUE:	43792
BENEFIT COST RATIO:	2.25
INTERNAL RATE OF RETURN:	8.3%
COMPOSITE RATE OF RETURN:	5.19%
TARGETS	
VOLUME REMOVED:	91
VOLUME PROTECTED:	123

Table 3.--Southern pine beetle economic analysis for the Marine Corps Base, Camp Lejeune at 10 percent discount rate.

CAMP LEJEUNE 09/30/83

WITHOUT A PROJECT

AGE	HARV OBJ.	VOLUME LOST (MCF)	SPOT GROWTH RATE	VOLUME THREAT (MCF)	GROWTH RATE (%)	AGE AT HARV.	VOLUME AT HARVEST (MCF)	PRICE AT HARV.	VALUE AT HARVEST	PRESENT VALUE
30	S/F	5	2.70	14	1.0	100	28	$ 3060	$ 85147	$ 98
30	S/I	3	2.70	9	1.4	70	16	$ 1689	$ 27001	$ 542
30	S/F	7	2.70	18	1.0	100	37	$ 3060	$ 113382	$ 131
40	S/F	8	2.71	21	.7	100	32	$ 2510	$ 80024	$ 239
40	S/I	5	2.71	14	.9	70	18	$ 1386	$ 25410	$ 1324
40	S/F	10	2.71	27	.7	100	43	$ 2510	$ 106699	$ 319
50	S/I	3	2.71	7	.7	70	8	$ 1137	$ 9130	$ 1234
50	S/F	5	2.71	14	.6	100	19	$ 2059	$ 38340	$ 297
TOTAL		46		123			200	$	$ 485134	$ 4183

VALUE OF THE VOLUME NOT SALVAGED (LOST) $ 27331

TOTAL VALUE LOST $ 31514

WITH A PROJECT

AGE	HARV OBJ.	VOLUME LOST (MCF)	SPOT GROWTH RATE	VOLUME THREAT (MCF)	GROWTH RATE (%)	AGE AT HARV.	VOLUME AT HARVEST (MCF)	PRICE AT HARV.	VALUE AT HARVEST	PRESENT VALUE
	S/F	0	2.70	0	1.0	100	0	$ 3060	$ 0	$ 0
30	S/I	0	2.70	0	1.4	70	0	$ 1689	$ 0	$ 0
30	S/F	0	2.70	0	1.0	100	0	$ 3060	$ 0	$ 0
40	S/F	0	2.71	0	.7	100	0	$ 2510	$ 0	$ 0
40	S/I	0	2.71	0	.9	70	0	$ 1386	$ 0	$ 0
40	S/F	0	2.71	0	.7	100	0	$ 2510	$ 0	$ 0
50	S/I	0	2.71	0	.7	70	0	$ 1137	$ 0	$ 0
50	S/F	0	2.71	0	.6	100	0	$ 2059	$ 0	$ 0
TOTAL		0		0			0	$	$ 0	$ 0

VALUE OF THE VOLUME NOT SALVAGED (LOST) $ 0

TOTAL VALUE LOST $ 0

PROJECT BENEFITS:	31514
TOTAL PROJECT COST:	35000
NET PRESENT VALUE:	-3486
BENEFIT COST RATIO:	.9
INTERNAL RATE OF RETURN:	8.3%
COMPOSITE RATE OF RETURN:	9.84%
TARGETS	
VOLUME REMOVED:	91
VOLUME PROTECTED:	123

LITERATURE CITED

Barry, P. J. and A. E. Landgraf. 1969. Bark Beetle Detection Survey, Camp Lejeune Marine Corps Base, North Carolina. Asheville Field Office Report No. 69-1-34, January 1969.

Barry, Patrick J. 1981. Biological Evaluation of Southern Pine Beetle Infestations on Camp Lejeune Marine Corps Base, North Carolina. USDA Forest Service, Forest Pest Management, Asheville Field Office Report No. 81-1 24, March 1981.

Doggett, Coleman A. 1983. Forest Pest Newsletter. Division of Forest Resources, Raleigh, North Carolina. Vol. 25, No. 5. August 1983.

Doggett, Coleman A. 1983. Forest Pest Newsletter, Raleigh, North Carolina. Vol. 25, No. 4. July 1983.

Forest Pest Management
Doraville Field Office

Report #83-3-29
September 30, 1983

BIOLOGICAL EVALUATION OF SOUTHERN PINE BEETLE INFESTATIONS AT THE MARINE CORPS BASE, CAMP LEJEUNE IN NORTH CAROLINA

Prepared by: William A. Carothers
William A. Carothers
Entomologist

Debra Allen
Debra Allen
Entomologist

Approved by: James D. Ward
for: Harvey V. Toko
Director, Forest Pest Management